

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (canceled)

2. (currently amended) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the device having a tip and being gradually inserted into the object from the tip thereof, comprising:

detection means for detecting a position of a tip of the device within the object; and

movement state display means for displaying information in relation to a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means;

~~The magnetic resonance imaging system according to claim 1,~~ wherein the movement state display means includes

production means for producing, as the information in relation to the movement state, movement locus data indicative of an inserted part of the device from the data indicative of the position of the tip detected by the detection means; and

movement locus display means for displaying the movement locus data produced by the production means.

3. (previously presented) The magnetic resonance imaging system according to claim 2, wherein the production means includes means for marking the data indicative of the position of the tip at every appropriate time instant, and means for grouping the data existing between the marked time instants at every marking, the grouped data being outputted as the movement locus data,

wherein the movement locus display means is configured to display the grouped data in different modes group by group.

4. (previously presented) The magnetic resonance imaging system according to claim 3, wherein the device has an operating handle portion handed by an operator, the operating handle portion being located at an end opposite to the tip, and the production means includes operation means, which is arranged at the operating handle portion of the device, for generating a signal for the marking the data.

5. (previously presented) The magnetic resonance imaging system according to claim 3, wherein the movement locus display means is configured to

display the grouped data in either one of different degrees of intensity or different kinds of color.

6. (previously presented) The magnetic resonance imaging system according to claim 5, wherein the movement locus display means is configured to display the grouped data in either one of different degrees of intensity or different kinds of color depending on a period of time elapsing after each grouping.

7. (previously presented) The magnetic resonance imaging system according to claim 2, wherein the movement locus display means is configured to display the movement locus data produced by the production means superimposed on a reference image.

8. (canceled)

9. (currently amended) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the device having a tip and being gradually inserted into the object from the tip thereof, comprising:
detection means for detecting a position of a tip of the device within the object; and

movement state display means for displaying information in relation to a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means,

wherein the movement state display means is configured to display the data indicative of the position of the tip detected by the detection means, together with time information indicative of a sequence of time in detecting the data; and

~~The magnetic resonance imaging system according to claim 8, wherein the~~
time information indicative of the sequence of time is one of intensity degrees for displaying the data of the position, different hues for displaying the data of the position, and thinning degrees of data for displaying the data of the position.

10. (canceled)

11. (currently amended) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the device having a tip and being gradually inserted into the object from the tip thereof, comprising:

detection means for detecting a position of a tip of the device within the object; and

movement state display means for displaying information in relation to a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means,

~~The magnetic resonance imaging system according to claim 1,~~ wherein the detection means has a ~~mini~~ RF detection coil attached on the tip of the device, means for acquiring, together with application of a gradient magnetic field ~~gradient~~ to the RF detection coil, an MR signal from a vicinity of the RF detection coil excited by an RF magnetic field, and means for obtaining a position of the RF detection coil as the position of the tip through a frequency analysis of the MR signal.

12. (original) The magnetic resonance imaging system according to claim 11, wherein the RF detection coil is one in number and attached on the tip of the device.

13. (canceled)

14. (previously presented) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, in which an image of a section of the object being obtained from an MR signal

acquired through application of a magnetic field based on a given pulse sequence to the object, comprising:

position detecting means for detecting positional information of the device;

and

control means for controlling imaging parameters included in the pulse sequence on the basis of the positional information detected by the position detecting means so that the section always contain the device.

15. (currently amended) The magnetic resonance imaging system according to claim 14, wherein the position detecting means includes a sensor comprising one of a ~~mini~~ RF detection coil, a magnetism detecting member, and a marker member outputting an MR signal.

16. (original) The magnetic resonance imaging system according to claim 15, wherein the sensor is composed of at least two sensors attached to a main body of the device.

17. (original) The magnetic resonance imaging system according to claim 15, wherein the sensor is composed of at least two sensors attached to one of a support portion of the device and a grip portion of the device.

18. (previously presented) A magnetic resonance imaging system for interventional MRI involving operations to insert a device into an object, in which an image of a section of the object being obtained from an MR signal acquired through application of a magnetic field based on a given pulse sequence to the object, comprising:

preoperative plan means for planning information in relation to the operations of the device based on the image prior to the operations; and

output means for outputting, in association with the object, the information in relation to the operations planned by the preoperative plan means.

19. (previously presented) The magnetic resonance imaging system according to claim 18, wherein the preoperative plan means is configured to plan as the information a target's position, an insertion start position on an object body, and a path connecting the target's position and the insertion start position, all of which is necessary when the device is inserted into the body.

20. (previously presented) The magnetic resonance imaging system according to claim 19, wherein the output means is configured to indicate at least the insertion start position of the device on the object body.

21. (previously presented) The magnetic resonance imaging system according to claim 20, wherein the outputting means includes a light projector for projecting, onto the object body, light showing at least the insertion start position of the device.

22. (original) The magnetic resonance imaging system according to claim 18, wherein the device is a puncture needle and the plan is a plan for needling the puncture needle.

23. (previously presented) A method of preparing for interventional MRI involving operations of a device to be inserted into an object, the method comprising the steps of:

acquiring an image of a section of the object through MR imaging performed with the object laid on a couch;

planning, before the operations, information in relation to the operations of the device based on the image while the object is laid on the couch; and

outputting the planned information in association with the object.

24. (previously presented) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the

device having a tip and being gradually inserted into the object from the tip thereof, comprising:

a detection unit detecting a position of the tip of the device within the object; and

a movement display unit displaying information in relation to a temporally-traced movement of an inserted part of the device on the basis of data indicative of the position of the tip detected by the detection means.

25. (previously presented) The magnetic resonance imaging system according to claim 24, wherein the movement display unit includes

production means for producing, as the information in relation to the temporally-traced movement, a locus of movement indicative of the inserted part of the device on the basis of the data indicative of the position of the tip detected by the detection unit; and

movement locus display means for displaying the locus of the movement produced by the production means.

26. (previously presented) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, comprising:

detection means for detecting a position of a tip of the device; and

movement state display means for displaying a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means;

wherein the movement state display means includes production means for producing movement locus data indicative of the device from the data indicative of the position of the tip detected by the producing means; and display means for displaying the movement locus data produced by the production means.

27. (previously presented) The magnetic resonance imaging system according to claim 26, wherein the production means includes means for marking the data indicative of the position of the tip at every appropriate time instant, and means for grouping the data existing between the marked time instants at every marking, the grouped data being outputted as the movement locus data, wherein the display means is composed of means for displaying the grouped data in different modes group by group.

28. (previously presented) The magnetic resonance imaging system according to claim 27, wherein the production means includes operation means, arranged at an operating handle portion of the device, for generating a signal for the marking.

29. (previously presented) The magnetic resonance imaging system according to claim 27, wherein the display means is composed of means for displaying the grouped data in different degrees of intensity or different kinds of color.

30. (previously presented) The magnetic resonance imaging system according to claim 29, wherein the display means is composed of means for displaying the grouped data in different degrees of intensity or different kinds of color depending on a period of time elapsing after each grouping.

31. (previously presented) The magnetic resonance imaging system according to claim 26, wherein the display means is composed of means for displaying the movement locus data produced by the production means on a reference image in a superimposition manner.

32. (previously presented) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, comprising:

detection means for detecting a position of a tip of the device; and

movement state display means for displaying a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means;

wherein the movement state display means is composed of means for displaying the data indicative of the position of the tip detected by the detection means, together with information indicative of a sequence of time in detecting the data; and

the information indicative of the sequence of time is one of intensity degrees for displaying the data of the position, different hues for displaying the data of the position, and thinning degrees of data for displaying the data of the position.

33. (currently amended) A magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, comprising:

detection means for detecting a position of a tip of the device; and

movement state display means for displaying a movement state of the tip of the device on the basis of data indicative of the position of the tip detected by the detection means;

wherein the detection means has a ~~minute~~ RF detection coil attached on the tip of the device, means for acquiring, together with application of a gradient

magnetic field gradient, an MR signal from a vicinity of the RF detection coil excited by an RF magnetic field, and means for obtaining a position of the RF detection coil as the position of the tip through a frequency analysis of the MR signal.

34. (previously presented) The magnetic resonance imaging system according to claim 33, wherein the RF detection coil is one in number and attached on the tip of the device.

35. (canceled)

36. (previously presented) A method of using a magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the device having a tip and being gradually inserted into the object from the tip thereof, the method comprising:

detecting a position of the tip of the device within the object; and

displaying information in relation to a temporally-traced movement of an inserted part of the device on the basis of data indicative of the detected position of the tip.

37. (previously presented) The method according to claim 36, wherein the information is displayed on a movement display unit which produces, as the information in relation to the temporally-traced movement, a locus of movement indicative of the inserted part of the device on the basis of the data indicative of the detected position of the tip, and displays the produced locus of movement.

38. (previously presented) A method of using a magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the method comprising:

detecting a position of a tip of the device; and

displaying a movement state of the tip of the device on the basis of data indicative of the detected position of the tip;

wherein displaying the movement state includes: producing movement locus data indicative of the device from the data indicative of the detected position of the tip and displaying the produced movement locus data.

39. (previously presented) The method according to claim 38, wherein producing the movement locus data includes marking the data indicative of the position of the tip at every appropriate time instant, and grouping the data existing between the marked time instants at every marking, the grouped data

being outputted as the movement locus data, and wherein displaying the produced movement locus data includes displaying the grouped data in different modes group by group.

40. (previously presented) The method according to claim 38, wherein the produced movement locus data is displayed on a reference image in a superimposition manner.

41. (previously presented) A method of using a magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the method comprising:

detecting a position of a tip of the device; and

displaying a movement state of the tip of the device on the basis of data indicative of the detected position of the tip;

wherein the displaying of the movement state includes displaying the data indicative of the detected position of the tip, together with information indicative of a sequence of time in detecting the data; and

the information indicative of the sequence of time is one of intensity degrees for displaying the data of the position, different hues for displaying the data of the position, and thinning degrees of data for displaying the data of the position.

42. (currently amended) A method of using a magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, the method comprising:

detecting a position of a tip of the device; and

displaying a movement state of the tip of the device on the basis of data indicative of the detected position of the tip;

wherein detecting the position of the tip of the device includes:

attaching a ~~minute~~ RF detection coil on the tip of the device;

acquiring, together with application of a gradient magnetic ~~field~~gradient, an MR signal from a vicinity of the RF detection coil excited by an RF magnetic field; and

obtaining a position of the RF detection coil as the position of the tip through a frequency analysis of the MR signal.

43. (previously presented) A method of using a magnetic resonance imaging system for interventional MRI involving an operation to insert a device into an object, in which an image of a section of the object is obtained from an MR signal using an MR signal acquired through application of a magnetic field based on a given pulse sequence to the object, the method comprising:

detecting positional information of the device; and

controlling imaging parameters included in the pulse sequence on the basis of the detected positional information so that the section always contain the device.

44. (previously presented) A method of using a magnetic resonance imaging system for interventional MRI involving operations to insert a device into an object, in which an image of a section of the object is obtained from an MR signal based on an MR signal acquired through application of a magnetic field based on a given pulse sequence to the object, the method comprising:

preoperatively planning information in relation to the operations of the device based on the image prior to the operations; and

outputting the planned information in relation to the operations in association with the object.